DDT RESIDUAL SPRAY OPERATIONS

FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
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Material in this handbook is not for publication.

This manual describes the operations of the Extended Malaria Control Program which utilizes residual DDT spraying of homes as a method of malaria control. The Extended Program, initiated by the Office of Malaria Control in War Areas, is now being administered by its successor, the Communicable Disease Center of the U. S. Public Health Service.

TABLE OF CONTENTS

DDT

RESIDUAL SPRAY PROGRAM

DDT insecticide used as a residual spray in houses is a new weapon of attack against an old enemy — MALARIA.

When solutions or emulsions of DDT are sprayed on walls and ceilings, an almost invisible residual deposit of DDT crystals is left on the surface. Malaria mosquitoes and other insects which come in contact with these crystals are poisoned. They die later if they have received a sufficient exposure.

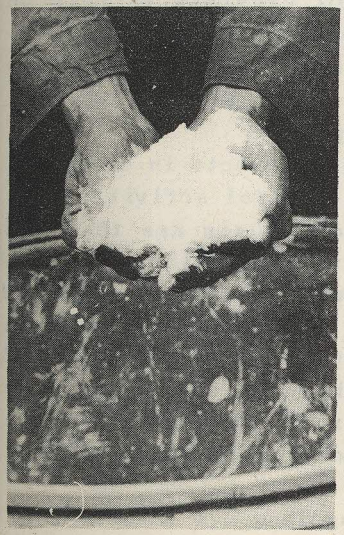
This method of killing insects is especially valuable in malaria control activities because mosquitoes inside houses are the ones which are most likely to bite malaria sufferers and thus become infected. These *infected mosquitoes* have ample opportunity to rest on treated surfaces in houses sprayed with DDT and *be killed* before they can spread the disease to uninfected persons. This is the basic principle of malaria control through residual spraying.

DDT residual spraying is a new insecticidal technique. Before it could be put to extensive use in malaria control programs, it has been

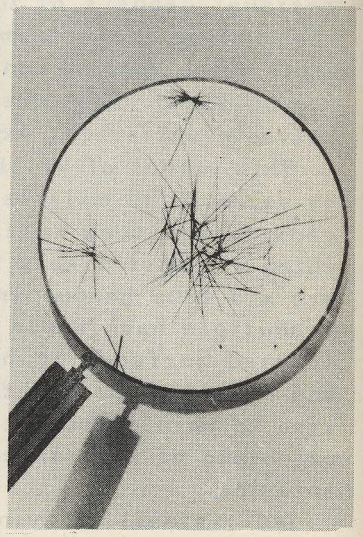
necessary to develop new formulas, make changes in spraying equipment, and devise new methods of spraying.

This handbook supplies detailed information about formulas used for concentrates and spray mixtures, latest spraying methods, care and use of equipment, and safe practices in handling DDT in U.S.P.H.S. malaria control operations. Suggestions for dealing with the public are also given. The handbook is intended for use by project supervisors and as an aid in training spraying crews.

Men in the field who use this handbook are encouraged to send in suggestions and criticisms. These will be helpful in compiling future editions.



Dry DDT Resembles Flour



Magnified DDT Crystals

WHY WE USE DDT SPRAY

The discovery of DDT as a means for checking the spread of insect-borne diseases is one of the major scientific achievements of World War II. Even when used in very small quantities, DDT is effective against a wide variety of insect pests. The most striking feature of DDT spray is the power of the residue to kill insects which may walk over it months after it has been applied.

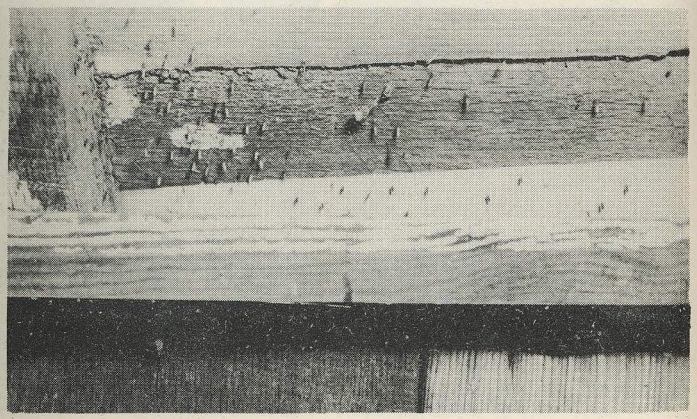
DDT (dichloro-diphenyl-trichloroethane) is a fine white powder which has a tendency to become lumpy when not mixed with other substances. It dissolves only slightly in water but is soluble in kerosene, xylene, toluene, Solvesso, Velsicol, fuel oil, and similar solvents. As a spray, DDT can be used effectively in oil solutions, emulsions, aqueous suspensions, and exhaust-generated sprays.

Emulsion sprays of DDT give satisfactory residual toxicity when applied to surfaces such as unpainted wood and plaster; to fabrics such as mohair, cotton, wool, and canvas; to well-dried paints and varnishes; to wallpaper; and to wire screens which have not become rusted. Low residual toxicity results when these sprays are used on mud or adobe surfaces, linoleum, fresh paints and varnishes, and some whitewashed surfaces.

On fabrics or wood surfaces deposits from 5 percent DDT emulsion sprays are not objectionable. On wallpaper or painted and varnished

surfaces, care must be used to prevent over-application, for runs cause spotting and streaking. An even application of the spray on high-gloss surfaces will usually cause the gloss to become dull. DDT crystals may show on such surfaces as glass, shiny metals, and dark enamels, so these should be avoided in spraying rooms where appearance is an important factor to be considered. The solvents used in DDT emulsion sprays may react to cause a temporary softening or stickiness in fresh paints and varnishes.

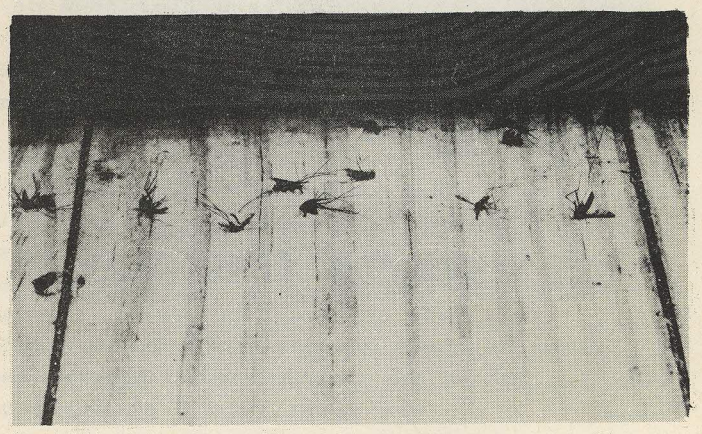
Exactly how DDT kills insects is not fully understood. Evidently the DDT is absorbed through the insects' feet as they rest on or walk over sprayed surfaces. After a short period of exposure the affected insects become restless, drag their legs, become jerky and spasmodic in their movements, develop tremors, and finally die.



Anopheles Resting on Ceiling

DDT is not a repellent. The residue of crystals left after the spray dries is not offensive to insects lighting upon it. Mosquitoes entering a treated room rest quietly on walls and ceilings. After exposure of 5 to 10 minutes or longer, however, they become restless and may try to escape. When first affected, more than half the mosquitoes move toward the light. They may escape from the room and die elsewhere. Usually they receive a toxic dose before they leave the treated area. Hence, the householder should not be disappointed at not finding a large number of dead mosquitoes in the house. Success of the DDT treatment should be judged by the absence of live insects, not by the presence of dead ones.

DDT residual spraying is now accepted as an effective malaria control measure. *Anopheles quadrimaculatus* has the characteristic habit



Anopheles Killed by DDT

of resting on walls and ceilings in houses, privies, and other buildings before and after feeding and during the day. Since about two weeks must elapse after this mosquito bites an infected person before it can transmit the disease, there is ample time for mosquitoes in or about treated houses to secure a lethal dose of DDT.

In a malaria control program DDT spraying is intended primarily to kill *Anopheles* mosquitoes which could transmit malaria. This spray is helpful, however, in the control of other insect pests, such as houseflies, cockroaches, and fleas. For controlling bedbugs, the mattresses and bedsteads must be sprayed. The specific habits of each household pest must be considered when these insects are being attacked with DDT. (See bulletin "DDT FOR CONTROL OF HOUSEHOLD PESTS AFFECTING HEALTH" issued by CDC Headquarters Office.)

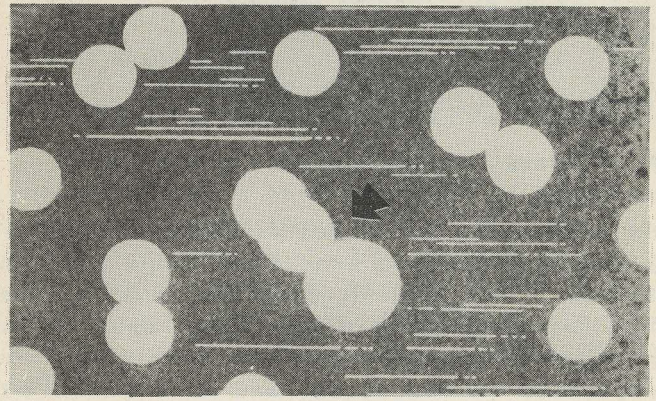
The indirect benefits resulting from destruction of these additional household insect pests creates a generally favorable public attitude toward the residual spray program for malaria control.

DDT EMULSION CONCENTRATE

Xylene has been used extensively as a solvent for DDT on the residual spray program because it dissolves relatively high percentages of pure DDT powder, does not stain, and

is inexpensive. DDT can be applied also in various oil solutions or other organic solvents such as Solvesso or Velsicol.

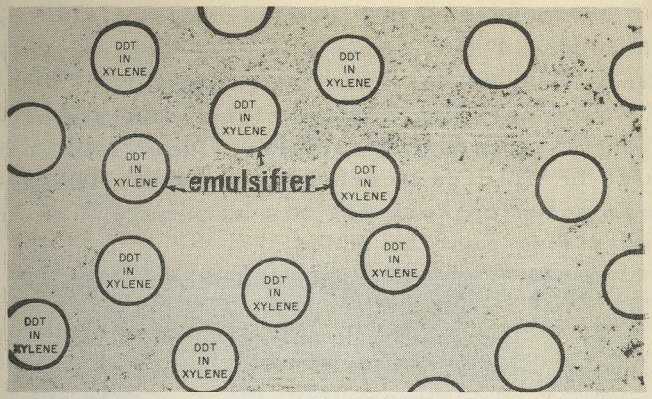
Since only small quantities of DDT are necessary for spraying purposes, these solutions must be diluted further with water. DDT-xylene solution does not mix with water, so an emulsifier must be added.



Suspended Drops Combining Without an Emulsifier

An emulsion differs from a solution. DDT dissolved in xylene forms a DDT-xylene *solution*. To form an emulsion, water and an emulsifier must be added. DDT-xylene placed in water and shaken violently breaks up into tiny drops, which are dispersed throughout the water. If the mixture is allowed to stand, these drops combine to form larger and larger drops, until the DDT-xylene and the water have separated.

If an emulsifier, such as Triton, is added



DDT — Xylene + Water + Triton = A Stable Emulsion

and the mixture is shaken violently, the DDT-xylene is broken up into fine drops: but in this instance each drop is surrounded by a thin layer of emulsifier. This layer keeps the drops from combining. Thus they remain in suspension in the water, and an *emulsion* of DDT-xylene is formed.

DDT-xylene emulsion spray contains about 86 percent water. To avoid the expense of transporting such large quantities of water in the ready-to-use spray, formulas for DDT-xylene-Triton emulsion *concentrate* have been developed. These can be diluted properly with water at the job site.

Xylene dissolves greater percentages of DDT in warm temperatures. For this reason, a 35 percent concentrate is used in the summer when temperatures are above 50° F. During the winter and early spring, when temperatures are below 50° F., a 20 percent DDT concentrate must

be used.* The basic formulas for winter and summer concentrate are given below.

DDT concentrate should always be prepared at as high a natural temperature as possible, for xylene dissolves DDT much faster at high temperatures.

FORMULA FOR DDT CONCENTRATE

	SUMMER FORMULA	WINTER FORMULA
DDT	3 lbs.	1 lb.
XYLENE	3 qts.	2 qts.
TRITON X-100	6 fluid oz.	3.2 fluid oz.
or		
TRITON X-155	3 fluid oz.	1.6 fluid oz.

Temperatures of the storage places for DDT concentrate must be considered. If these temperatures remain above 50°F., the summer formula should be used. If temperatures below 50°F. are anticipated, use the winter formula. Special quantity formulas have been devised for the various mixers recommended in this handbook.

To prepare DDT spray in proper dilution for summer use, mix one part of summer concentrate with six parts of water; for winter use, mix one part of winter concentrate with three parts of water. This results in a 5 percent DDT spray containing 50 mg. DDT for each cubic centimeter of spray solution. When this milky liquid is sprayed on a surface, the water and xylene evaporate, leaving the desired residue of DDT crystals.

*Not a true percentage — expressed in percentage form for simplicity.

Barrel Type Hand Mixer

HAND MIXING DDT CONCENTRATE

Several types of hand mixers may be used. A 50-gallon barrel mounted on rockers is a simple device permitting agitation with minimum effort. Its mixing capacity is from 25 to 30 gallons.

Formula for Rocker Mixer

	SUMMER-35% DDT	WINTER-20% DDT
DDT	84 pounds	44 pounds
XYLENE	21 gallons	22 gallons
TRITON X-100	5 qts., 1 cup	4 qts., 2 cups
or		
TRITON X-155	5 pts., ½ cup	2 qts., 1 cup

PROCEDURE:

(1) Pour XYLENE and DDT into mixing barrel.
(2) Rock the barrel for 10 to 15 minutes or until DDT solution is clear.
(3) Draw test sample into glass. If sample is cloudy continue rocking.
(4) When the sample is clear, add TRITON and continue mixing for a few minutes.

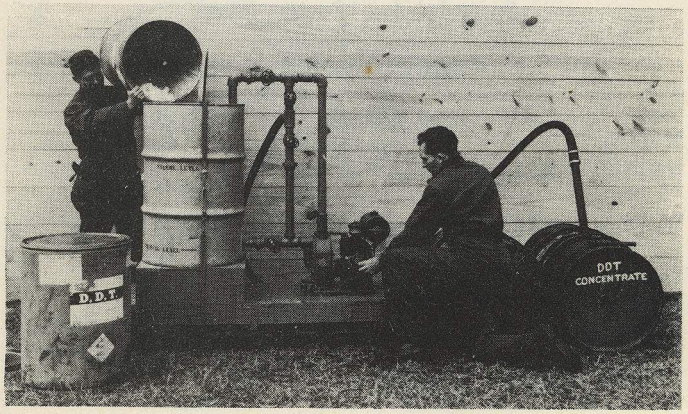
(5) Draw finished concentrate into 5-gallon cans. Label.

PRECAUTIONS:

(1) Mix DDT concentrate *outdoors* whenever possible. Use ventilating fan if indoor mixing is necessary.
(2) Wear xylene-resistant, moisture-proof *gloves* while handling DDT, xylene, or concentrate.
(3) *Avoid spilling* concentrate on clothing or skin *Change clothes* immediately if they become soaked, and wash the skin.
(4) Follow *safe practices* outlined on pages 53-57.

POWER MIXING DDT CONCENTRATE

Where large quantities of DDT concentrate must be mixed, a power-driven mixer can be used. A recommended type consists of a 55-gallon steel drum and a gasoline engine pump assembly mounted in a fixed position on a hand-barrow.



Power Mixer in Operation

platform. When empty, the unit can be lifted easily by two men and can be transported readily on a small truck.

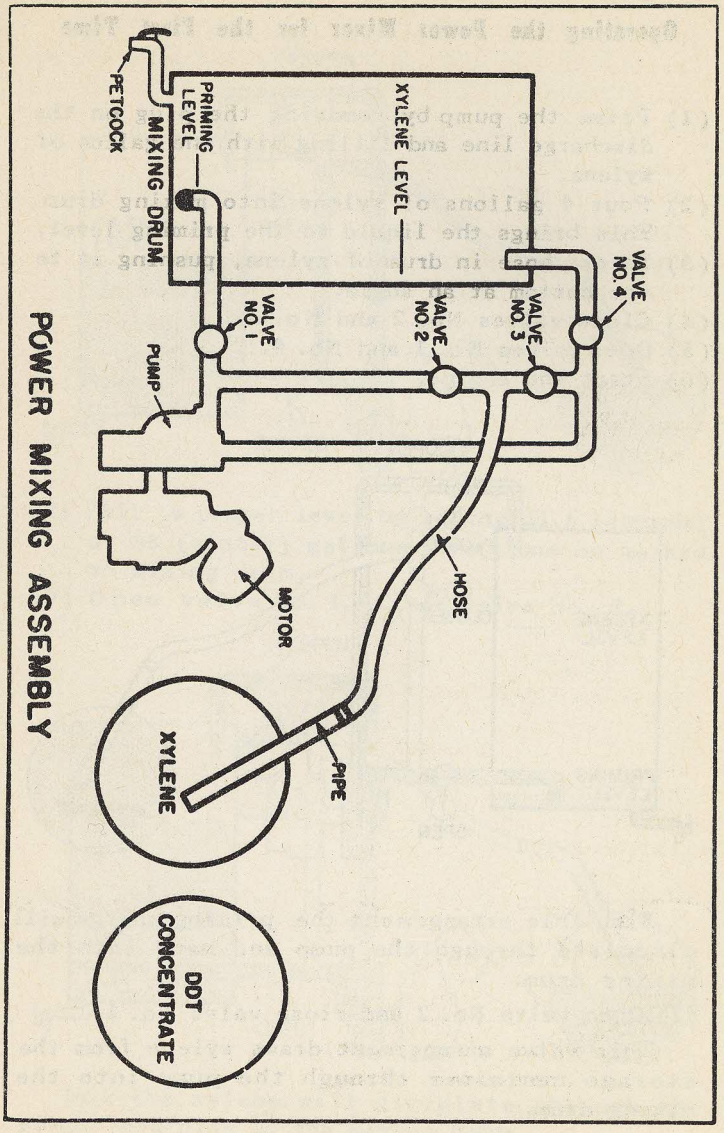
Valves and piping are arranged to permit (1) pumping xylene into the mixing drum, (2) circulating the DDT-xylene-Triton mixture through the pump every 2 to 3 minutes for mixing purposes, and, (3) pumping the mixed concentrate into 55-gallon drums for storage and shipment.

Centrifugal pumps must be primed before they are used. This can be done by maintaining a level in the mixing drum that will cover the suction strainer. This level should be indicated by a mark on the inside of the drum.

Procedures for operating the power mixer for the first time and on routine runs are given on pages 14-17. Study the diagrams carefully, so that you understand the direction of flow under each set of valve arrangements.

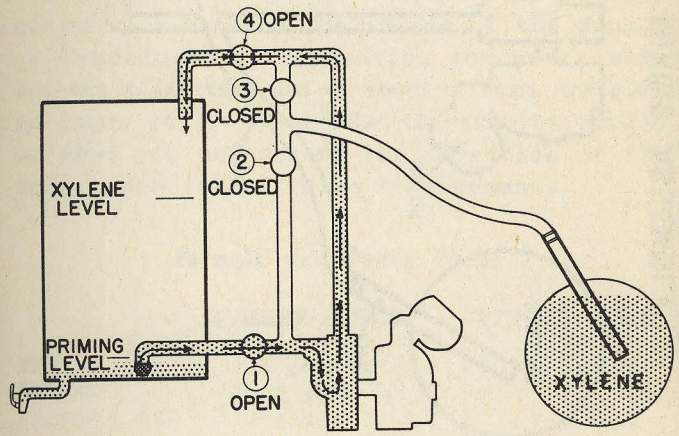
Formula for Power Mixer

	SUMMER-35% DDT	WINTER-20% DDT
DDT	125 pounds	70 pounds
XYLENE	31.5 gallons	35 gallons
TRITON X-100	1 gallon	7 quarts
or		
TRITON X-155	1 gallon	7 pints
PRIMING CHARGE		
DDT	20 pounds	10 pounds
XYLENE	5 gallons	5 gallons
TRITON X-100	1 quart	1 quart
or		
TRITON X-155	1 pint	1 pint



Operating the Power Mixer for the First Time

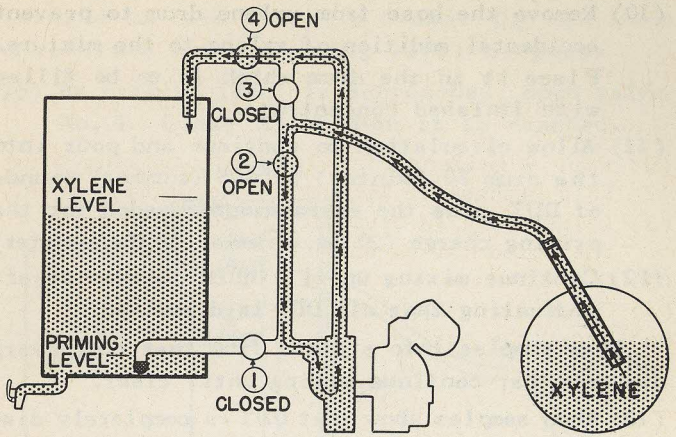
(1) Prime the pump by removing the plug on the discharge line and filling with one gallon of xylene.
(2) Pour 4 gallons of xylene into mixing drum. This brings the liquid to the priming level.
(3) Insert hose in drum of xylene, pushing it to the bottom at an angle.
(4) Close valves No. 2 and No. 3.
(5) Open valves No. 1 and No. 4.
(6) Start the engine.



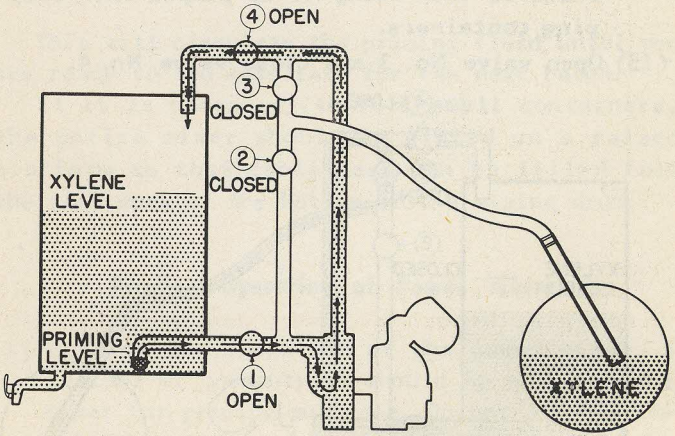
With this arrangement the priming charge will circulate through the pump and back into the mixing drum.

(7) Open valve No. 2 and close valve No. 1.

This valve arrangement draws xylene from the storage container through the pump into the mixing drum.



(8) Fill to proper level by adding 31.5 (summer) or 35 (winter) gallons of xylene as marked on mixing drum.
(9) Open valve No. 1. Close valve No. 2.



Now the xylene will circulate through the pump, returning to the mixing drum.

(10) Remove the hose from xylene drum to prevent accidental addition of xylene to the mixture. Place it in the drum which is to be filled with finished concentrate.

(11) Allow circulation to continue and pour into the drum 70 (winter) or 125 (summer) pounds of DDT, plus the extra amount needed for the priming charge (20 lbs. – summer, 10 lbs. – winter).

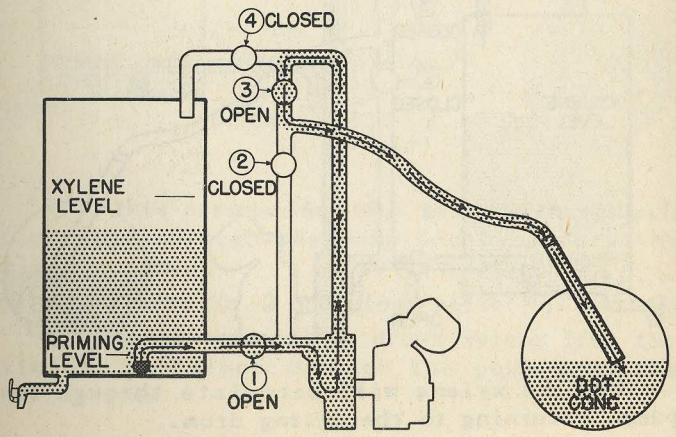
(12) Continue mixing until liquid becomes clear, indicating that all DDT is dissolved.

Draw samples into a glass from test cock every few minutes; continue mixing until clear.

(13) When samples show that DDT is completely dissolved, add one pint TRITON X-100 for the priming charge plus the amount required by the basic formula (1 gal. – summer, 7 pts. – winter).

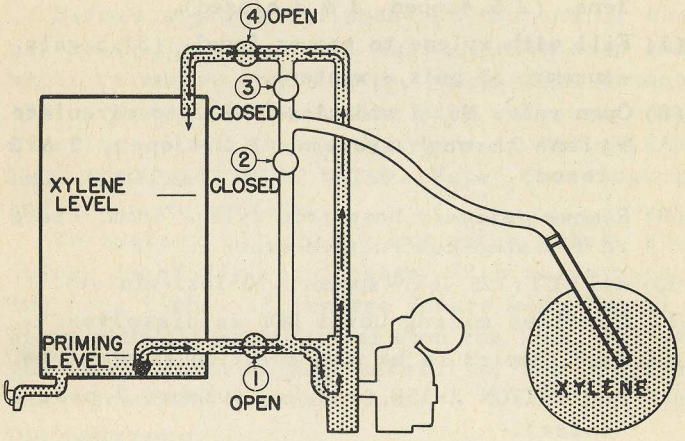
(14) Continue mixing at least 2 minutes; concentrate is then ready to be pumped into shipping containers.

(15) Open valve No. 3 and close valve No. 4.



The pump will now discharge concentrate from mixing drum into shipping drums. DO NOT draw concentrate below priming level of pump.

(16) As priming level is approached, open valve No. 4. Close No. 3 when it is reached.



This will circulate the priming fluid until you are ready to add materials for the next batch.

If it is necessary to fill small containers, the entire mixer should be placed on a raised platform so that containers can be filled from the test cock at the bottom of the mixing drum.

Routine Operation of Power Mixer

(1) For routine operation of the power mixer, 5 gallons of concentrate should be added to the mixer for priming purposes. Do not allow priming liquid to remain in the mixer overnight or for a longer period.

(2) Insert hose in xylene drum.

(3) Close valves No. 2 and No. 3.

(4) Open valves No. 1 and No. 4.

(5) Start engine and circulate priming fluid.

(6) Open valve No. 2 and close No. 1 to pump xylene. (2 & 4 open, 1 & 3 closed).

(7) Fill with xylene to proper level. (31.5 gals. -summer; 35 gals.- winter).

(8) Open valve No. 1 and close No. 2 to circulate xylene through system. (1 & 4 open, 2 & 3 closed).

(9) Remove delivery hose from xylene drum. Place in finished-concentrate drum.

(10) Add DDT (125 lbs.- summer; 70 lbs.-winter).

(11) Continue mixing until DDT is dissolved.

(12) Test samples to be sure solution is complete.

(13) Add TRITON X-155 (1 gal.- summer, 7 pts. - winter).

(14) Open valve No. 3, close No. 4, to pump concentrate into shipping container. DO NOT draw the level of the concentrate below the priming level. (1 & 3 open, 2 & 4 closed).

(15) As the priming level is approached open valve No. 4 and close No. 3 to circulate priming fluid. Continue as before (1 & 4 open, 2 & 3 closed).

At the end of each day's mixing, draw the priming charge into cans through the test cock at the bottom of the tank. Drain the pump, also. Seal the cans to prevent evaporation, label **SUMMER** or **WINTER** concentrate, and store for the next day's operations. The same charge may be used to

prime the pump when operations are started again. This procedure dispenses with the necessity of measuring additional quantities of xylene, DDT, or Triton for priming the mixer each time it is used.

Before storing equipment at the end of the day, wash the outside of the hose with soap and water to remove concentrate, which might damage the surface. If the mixing drum and pump need cleaning, flush them with xylene. **NEVER CLEAN THIS EQUIPMENT WITH WATER.** Water causes pump and piping to corrode.

Throughout all operations watch valves and joints carefully for leakage. Keep valve packing nuts tight. If leakage occurs wipe immediately with a clean rag, and stop the leak. Follow the above instructions carefully, and observe the precautions listed below.

PRECAUTIONS:

(1) Mix concentrate **OUTDOORS** when possible. Use ventilating fan for indoor mixing.

(2) Wear xylene-resistant, moisture-proof **GLOVES.**

(3) Don't spill concentrate on clothing or skin. Change clothes immediately if they become soaked with concentrate.

(4) Wash immediately any part of the body which comes in contact with soaked clothing.

(5) Observe **SAFE PRACTICES** in the use of DDT, as discussed on pages 50-55.

PREPARATION OF HOUSES

Occupants of the houses to be sprayed should be notified well in advance as to when the work is to start. Such notice may be given either by a member of the crew or by a special contact man. Thus the occupants have time to prepare their houses for spraying before the arrival of the spray crew.

This is particularly true when houses are to be sprayed around mealtime. If people are contacted in advance, they can have meals finished, dishes and food cleared away, and fires extinguished before the crew arrives. Otherwise, there may be a wait of an hour or so while these preparations are being made.

All furnishings should be moved away from the walls and toward the center of the room to clear the way for the operator to spray the walls and ceilings. Varnished furniture should be placed in the center of the room and covered before spraying begins.

The bed should be pulled away from the wall and the dresser turned so that its back is against the side of the bed (unless the back of the dresser is to be sprayed.) Low pieces of furniture should be placed at the foot of the bed. Everything must be covered.

In the living room, easy chairs and sofas are set back to back for ease in covering. High pieces are placed face to face if their backs are to be treated. Ordinary chairs may be stacked or used to hold small objects.

Preparations for spraying dining room furniture are much the same as for other rooms. Chairs are placed under the table, and sideboard, china closet, and other tables are turned upside down so that the under sides can be sprayed.

Removing Dishes and Food from Cupboards

In the kitchen care should be taken to see that all food and foodstuffs are protected from the spray. If cupboards are to be sprayed, food, dishes, and cooking utensils should be removed and placed elsewhere, or adequately covered so that the spray will not come in contact with them.

ALL THESE PREPARATIONS SHOULD BE MADE BY THE FAMILY BEFORE THE SPRAY CREW ARRIVES.

FINAL PREPARATIONS BY THE CREW

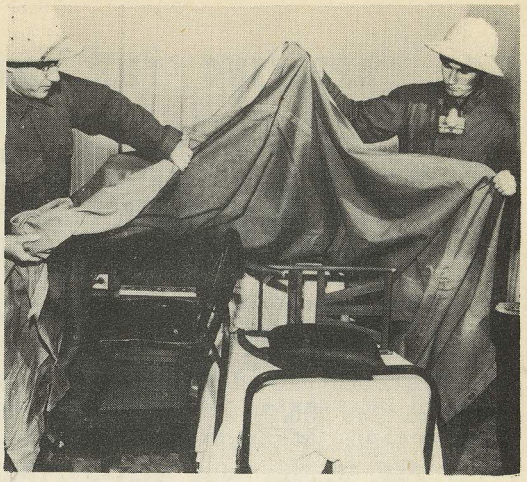
While the crew leader checks house preparations, the man at the truck should fill a pail with water and put a bar of soap in it, so that

good suds will be available when needed. Then the box of cover cloths should be placed on the ground or on the house porch. This leaves the back end of the truck clear for use as a work bench. The spray should now be prepared, as outlined on pages 38-41.

Upon entering homes, crew members should see that the sprayer is placed on cover cloths or papers or on surfaces which will not be marked or scratched. When all is ready, the stack of furniture should be covered with blankets or clothes so that the greatest advantage may be taken of the DDT spray. Spraying of blankets is equivalent to moth-proofing. Cover cloths may be used if blankets are not available or if the householder does not wish to use them. Varnished floors should be protected with newspapers. Shades should be lowered to avoid spotting window glass.

Cover Varnished Floors With Newspapers.

Cover Furniture With Blankets, Clothes, or Cover Cloths.



SUMMARY OF FINAL HOUSE PREPARATIONS

BEFORE SPRAYING OPERATIONS BEGIN go through the house and observe the following:

(1) See that all fires are extinguished.
(2) Be sure that varnished furniture is in center of room and completely covered.
(3) See that pictures, mirrors, and window hangings have been removed from walls.
(4) Examine closets for clothes which might be left hanging on the walls.
(5) Be sure that dishes, pots, pans, eating utensils, and food are covered or have been removed from the house.
(6) If floors are varnished, see that they are protected with newspapers.
(7) Lower window shades to prevent spotting the glass with spray.
(8) Test the spray nozzle OUTSIDE the house before starting work inside.

APPLYING THE SPRAY

The family should leave the house while the spray crew is working. Beginning in one corner, the operator should spray the walls uniformly with steady up and down motions. Dark or varnished areas, windows, or any glass surfaces should be avoided wherever possible, for these will spot.

When the walls are finished, the ceiling should be treated with the same steady spraying motion. If necessary, another section may be added to the wand so that the ceiling can be reached easily. When ceilings are being sprayed, the wand should be held at a slight angle, so that the spray pattern will not be directly overhead. As one swath is finished, the operator should step back a pace and do the next. If the sprayer is a hand pump type, it should be pumped up after every 4 or 5 minutes of use, or as recommended in the outlines for the different sprayers.

If the family wishes, washable work clothes may be sprayed. Clothes hanging on walls inside or outside the closets should be removed and the walls behind them sprayed. Every room should be sprayed. Spray porches, both screened and unscreened. Spray screens, too.

Spray under sides of beds and backs of large pieces of furniture, such as upright pianos, bureaus, dressers, tall chests, and cabinets, as mosquitoes may rest on these surfaces rather than on the walls. Edges of ceilings and walls are favorite resting places for mosquitoes

and should be sprayed carefully. Corners of rooms should receive special attention.

Proper application of the spray is very important. Spraying must be done so thoroughly that thousands of tiny, almost invisible DDT crystals remain distributed evenly on the walls and ceilings after the spray liquid has evaporated.

After spraying operations are completed for each house, members of the family may enter immediately if they wish, but a half hour should be allowed for the spray to dry and the xylene odor to disappear. Warn them that if they touch any wet surface a streak will remain when the spraying liquid dries.

The nozzle should be cleaned each time the tank is refilled, or as necessary. At the end of the day, follow the recommendations for care of the sprayers as outlined in this handbook. (See page 37).

HAND SPRAYING

The compressed air hand sprayer used in the program is a simple, easy-to-operate machine. For best results, it must be operated properly and kept in good repair.

The nozzle is the most important part of the sprayer. The nozzle aperture is designed to discharge the emulsion in a flat, fan-shaped spray which covers the walls evenly. The nozzle must be kept clean and free of clogging particles. It should never be allowed to rest on the ground or any other dirty surface.

The gaskets, air check valves, and hose are the weak points of the sprayer, so replacements for these parts should always be kept on hand.

After the flat-spray nozzle is installed and the sprayer modified, as suggested on page 35, test it to be sure that everything is in working order. Fill the tank half full of water, and put the pump in place. Turn the locking levers so that they catch under the flange of the tank, and turn the pump handle to screw the cover tightly in place. Pump to 50 pounds pressure per square inch. Hold the valve open and observe the spray. It should consist entirely of very fine particles, with no large drops present.

SPRAYING PRACTICE. New spray crews must be trained before actually applying the DDT in order to be able to cover the surface at approximately 190 square feet per minute. Before starting, observe the markings on the nozzle tip. The number 50 or the number 80 appears on the upper part of most nozzles. This number refers to the angle at which the spray leaves the nozzle. When DDT emulsion is used in a No. 50 nozzle, the angle of the spray is actually about 60°.

The number 015 or 02 is marked on the lower half of the nozzle. The number 015 indicates the rate at which the spray is discharged under pressure of 40 pounds per square inch (0.15 gallons per minute). A nozzle with 50 marked on the upper part and 015 on the lower is termed a 50015 nozzle; with 80 on the

upper part and 02 on the lower part, it is an 8002 nozzle.

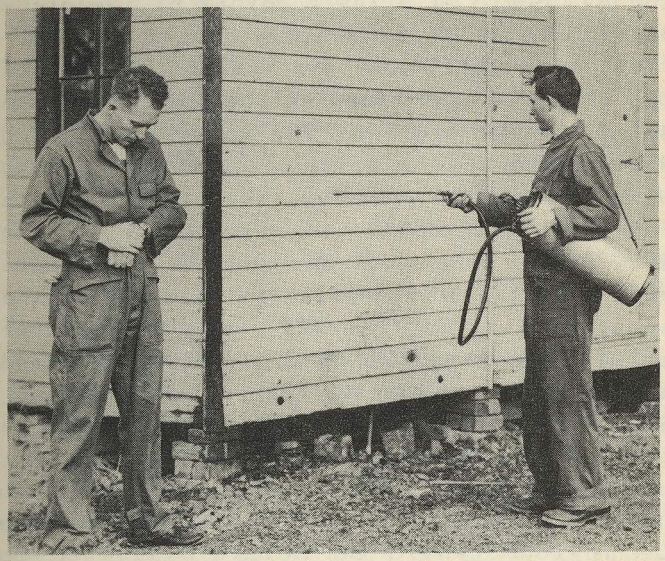
Have someone ready to time you as you practice. Hold the 50015 nozzle about 25 inches from the wall and the 8002 nozzle about 18 inches. Begin at a lower corner of the practice area, and move the spray upward in a vertical line until you have reached the top of the area. Without stopping the spray, step to one side the width of the spray swath, and spray down to the bottom. Continue in this manner until the practice area of 190 feet is covered. This should take one minute for the 8002 nozzle and about one and one-third minutes when the 50015 nozzle is used. Watch the spray pattern on the wall. Move the sprayer evenly and steadily in a straight line and not in angles or circles. Repeat the practice. Soon you will be able to judge your speed by the appearance of the spray on the wall.

If the speed of the wand movement is too slow for the workers when the above procedure is followed, hold the nozzle closer to the wall and speed up the motion of the wand. This does not increase the application rate of the DDT but gives even distribution over the entire surface.

As an example, if the wand movement is increased by one-fourth, the distance of the nozzle from the wall should be reduced in the same proportion (from 18 inches down to 13½ inches for an 8002 nozzle, or from 25 inches down to 19 inches for a 50015 nozzle).

Under some conditions it may be advisable

to decrease or increase the distance between the wall and the nozzle, and make an opposite change in the rate of application. This may be done advantageously in small or crowded rooms.



Practice Spraying

Some wall surfaces absorb the spray faster than others, so the proper amount of spray will not look the same on all walls. After you have had experience in spraying different types of walls, you will be able to judge your speed more readily by the appearance of the spray pattern.

In special cases, such as spraying very glossy surfaces, much of the spray will run

off in little streams. To correct this, hold the nozzle farther away from the wall, or move the wand faster. This should be done only when absolutely necessary, because when this occurs less than the necessary amount of DDT is being applied. If drops form on normal surfaces, or if dry spots are left on the sprayed surface, the nozzle is being held too far from the area being sprayed.

Practice many times until you know just how fast to move the nozzle and until you get into the habit of holding the particular nozzle which you are using at the proper distance from the wall. After you have become accustomed to using one type of nozzle, do not change to another type.

Spray Crew and Equipment

Most crews consist of one or two men and possibly a foreman. A half-ton pick-up truck or other suitable vehicle is used for transportation.

Model units usually include specially built equipment boxes that fit on the bed of the truck. A box containing several compartments is carried behind the cab. It holds the following pieces of equipment: two 5-gallon containers of concentrate, a pouring spout for the containers, a fire extinguisher, a quart measure marked to indicate cups and pints, a hose with threaded coupling at one end, and several sprayers.

A box placed in the middle of the truck carries miscellaneous equipment, such as spare parts for sprayers; soap; first-aid kit; xy-

lene-resistant, moisture-proof gloves; respirators; clean rags; oil cans; spare hose for sprayers; tubes of thread lubricant; and tools, including pliers, combination open-end and box wrench, and screw driver. Space is provided for dirty cloths.

A box near the end of the truck holds the cover cloths. Two pails can be placed on the floor of the truck in any vacant space. The water jug is carried in the cab so there will be no danger of its coming in contact with DDT.

For increased efficiency of operation and where an adequate supply of clean water is not available, it has been found most satisfactory to mix the spray emulsion in 55-gallon drums each morning at the warehouse before proceeding to the field. This is sufficient for one crew for an average day's work.

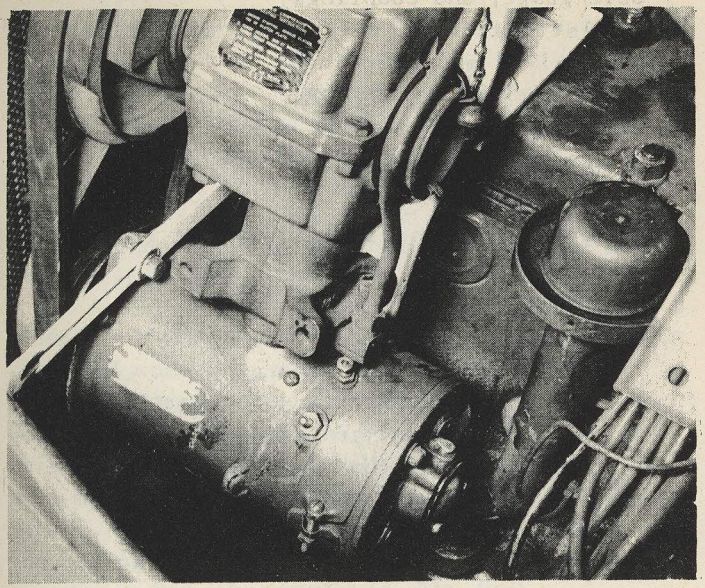
Use of Compressed Air Unit

Greater efficiency in the use of hand sprayers may be obtained by eliminating the hand pump. Compressed air is furnished from a tank on the truck (filled at warehouse or filling station) or from compressor units installed on the truck. The following are included in each unit:

1. Engine-mounted air compressor, Westinghouse "T-1"
2. Compressed air tank, 50-gallon
3. Copper tubing with couplings
4. Compressor mounting brackets (3 pc.) with 3 special cut nuts
5. Double generator pulley
6. Fan belts (2)
7. Tank inlet fittings (inlet check valve, pressure gauge, and couplings)
8. Outlet fittings (relief valve, outlet cut-off valve, and couplings)
9. Drain cock with coupling
10. Outlet hose, gauge, and chuck
11. Mounting frame, steel straps, angle irons, with necessary bolts

Installation should be made as follows on ½-ton trucks.

1. **Air Compressor.**
   (a) Remove present generator, generator adjustment bracket, and generator base bracket.
   (b) Install new generator base bracket.
   (c) Replace present generator pulley with new double pulley. (Use caution to prevent damage to generator shaft. Remove nut and pull pulley which is keyed to shaft).
   (d) Replace generator on new base bracket, and install new generator adjustment bracket.
   (e) Bolt compressor to bracket (as shown in photograph).
   (f) Remove 3 head nuts surrounding water pump on cylinder head.
   (g) Place bracket on cylinder head and fasten down with new special cut nuts.
   (h) Install belt from generator to compressor and special fan belt (see drawing).
   (i) Adjust generator and compressor to obtain correct belt alignment and tension.
2. **Compressed Air Tank.**
   (a) Set tank in wooden brackets and strap down as indicated in drawing.
   (b) Drill holes in floor of truck bed as indicated in the plan (p. 29).



(c) Install inlet fittings, outlet fittings, and drain cock on tanks as indicated in drawing, using a pipe compound to seal connections. (Suggested compound is Pat-A-Lac, manufactured by Patterson Sargent Co., Cleveland, Ohio. It is available from plumbing supply houses).

(d) Place mounted tank in truck and bolt to floor with angle irons.

(e) Attach outlet hose, gauge, and chuck to outlet fittings.

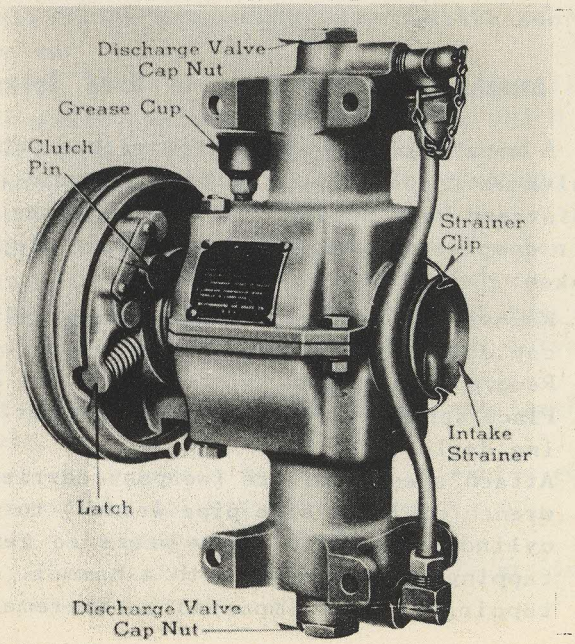
3. Copper Air Line.

(a) Bring end of tubing having 3/8 inch male fitting up through hole drilled in truck bed and fasten to inlet check valve.

(b) Run tubing (bending into place) under cab of truck along frame channel and up under engine side of cowling, fastening with staples, yokes, etc. Bend a coil (approximately 7 inches) in tubing to absorb partially the vibration differential between motor and frame. Fasten 1/4 inch female fitting to compressor outlet.

When installation of the compressed air unit is complete it should be tested as follows:

1. Engage the compressor manually by pushing in the clutch pin on the clutch wheel (see sketch). The motor must be stopped to do this.



2. Start the engine and operate at low speed (approximately 1200 R.P.M.).
3. Fill the tank until gauge reads 125 lbs.* (This will take approximately 17 minutes). Adjust relief valve by turning adjustment on top so that blow-off occurs at 125 pounds pressure. Test all connections for leaks and let stand; if air pressure drops, further checks should be made for leaks.
4. The air compressor is automatically disengaged simply by speeding up the motor to approximately 1750 R.P.M.
5. Each tank (50-gallon) will fill approximately 27 spray cans before pressure is reduced to 60 pounds, when recharging is necessary.

Attaching Schrader Valve to Hand Sprayer

A metal barrel bung fitted with a Schrader valve is the only part needed to convert the Lofstrand hand sprayer for use with the power air compressor unit. The following steps are taken:

1. Remove the 3 screws holding pump cylinder cap down.
2. Remove pump piston.
3. Place sprayer in large vise or similar holding device.
4. Attach special wrench (weapons carrier hub wrench or large size pipe wrench) to pump cylinder head and apply pressure gently, tapping wrench lever with a hammer. (This tapping is very important). Extreme care must be taken to avoid tearing the threaded sleeve loose from the tank.
5. Replace pump cylinder assembly with metal bung fitted with Schrader valve. A pipe joint compound should be used to seal the connection. Pat-A-Lac compound is suggested for this purpose.
6. Replace Lofstrand shut-off valve with Hudson shut-off valve No. 161. A 1/8 x 1/4 in. reducer and 1/8 x 1/4 bushing (iron pipe thread) should be purchased to adapt the wand to the Hudson shut-off and 1/4T nozzle.

Modifying Air Pressure Hand Sprayers

Some air pressure hand sprayers require modifications before using. The following are suggested:

1. Scrape paint from inside of sprayer lid. Otherwise, xylene removes paint, which is then sprayed on walls in small flecks.
2. Install flat-spray nozzle No. 1/4T8002 or 1/4T500515.
3. Remove catch from trigger shut-off valve so the valve can be closed immediately.
4. Place clamps on hose connection at gun.
5. Use pipe compound to prevent leaks at threaded connections.
6. Oil pump plunger sparingly to keep the leather soft.
7. Mark water levels for summer or winter concentrate by soldering wire inside tank.
8. Test the sprayer for leaks.
   (a) Place pressure gauge, reading to at least 100 lbs./sq. in., on spray gun.

(b) Fill tank half full of water. Replace pump and tighten. Invert sprayer to help seal gasket. Pump to 50 lbs./sq. in. pressure. Check for major leaks.

(c) Pour water on tank lid to test for leaks in the gasket.

(d) Check 5 minutes later for pressure.

9. Solder any seam leaks inside sprayer tank.
10. Stencil on outside of sprayer tanks the proper concentrate needed for each charge.
11. Solder a cup at the bottom of the tank for the nozzle, and a clip at the top for the wand.

List of Hand Spraying Equipment

1. Two 5-gallon containers for concentrate.
2. Respirators with extra filters.
3. Goggles with fog-proofing liquid.
4. Xylene-resistant, moisture-proof gloves.
5. Water jugs or drinking-water fountain.
6. Funnel.
7. Hose with threaded coupling at one end.
8. Measuring cup.
9. Pouring spouts for containers.
10. Several hand sprayers.
11. Tool kit with pliers, 13/16 inch combination open end wrench and box wrench, monkey wrench, pipe wrench, and screw drivers.
12. Quart measure marked in cups and pints.
13. Tubes of thread lubricant.
14. Fire extinguisher.
15. First aid kit.
16. Gasket shellac.
17. Cover cloths.

18. Two pails.
19. Clean rags.
20. Soap.
21. Talc.
22. Spare parts for sprayers.
23. Extra hoses for sprayers.
24. Oil can.

Care of Equipment at End of Day

1. Remove cap, tip, and strainer from nozzle; soak in xylene or kerosene.
2. Pour remaining spray solution in container for use next day. Do not place it with concentrate, as it is not the same strength.
3. Fill tank half full of water, slosh around, and empty by turning upside down.
4. Refill tank one-fourth full of clean water and spray out through hose and gun.
5. Wash outside of sprayer carefully, especially the hose and trigger.
6. Finish cleaning nozzle parts as follows:

(a) Inspect the tip carefully. If necessary, remove foreign matter by using a brush. Never clean the tip with a wire or a knife blade, as this part is carefully machined, and any scratches might change the spray pattern. Never adjust the position of the slot in the nozzle tip after it is in place, for the use of a screw driver will modify the spray pattern.

(b) Remove screen from strainer and clean by sloshing in xylene or kerosene.

(c) Reassemble nozzle, being sure to tight-

en the cap carefully but securely.
7. Place sprayers in rack, ready for the next day's work.

Summer Formulas for Use at Temperatures Above 50° F.

IN ANY 4-GALLON SPRAYER.

1. Mark 6-quart water level on inside of sprayer tank by soldering wire at proper level.
2. Fill tank to the mark with *clean water* (6 qts., or 1½ gallons).
3. Add 1 quart of summer concentrate.
4. Replace air pump and screw down tight.
5. Invert several times to mix the emulsion and help seal the lid gasket.
6. Pump 60 full strokes to get operating pressure of 50 lbs./sq. in. (If compressed air is available and the sprayer provided with a Schrader valve, 55 lbs. pressure may be built up in the sprayer. In this case, the entire contents may be sprayed without additional pumping).
7. Spray for about 4 minutes.
8. Repump 30 strokes to regain lost pressure.
9. Continue spraying until tank is empty.
10. Total spraying time is 8 to 9 minutes per charge for an 8002 nozzle. Spraying time with a 50015 nozzle is 10 to 12 minutes.
11. Total surface treated - about 1650 sq. ft. per charge.

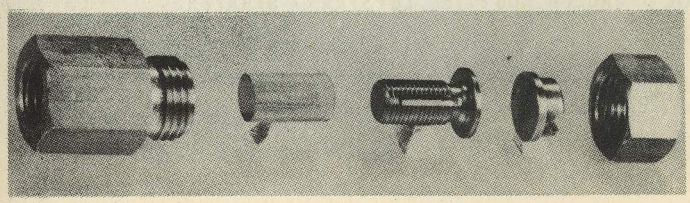
IN 3-GALLON MODIFIED LOFSTRAND SPRAYER.

1. Pour 4½ quarts of *clean water* into tank.
2. Add 3/4 quart of summer concentrate.

3. Replace filler cap.
4. Pump or admit air until the pressure is 55 lbs./sq. in.
5. Spray the entire charge.
6. Total spraying time — 6 to 7 minutes per charge for an 8002 nozzle; for a 50015 nozzle, 8 to 9 minutes.
7. Total surface treated — about 1250 sq. ft. per charge.

IN ANY 2½-GALLON SPRAYER.

1. Mark the 6-pint water level on the inside of the sprayer tank by soldering a piece of wire at the proper level.
2. Fill the tank to mark with *clean water*.
3. Add 1 pint of summer concentrate.
4. Replace air pump and screw down tight.
5. Invert several times to mix the emulsion and help seal the lid gasket.
6. Pump 45 full strokes to obtain proper operating pressure of 50 lbs./sq. in.
7. Spray for about 2 minutes.
8. Repump 18 strokes to regain lost pressure.
9. Continue spraying until tank is empty.
10. Total spraying time — 4 minutes per charge for an 8002 nozzle; 6 minutes per charge for a 50015 nozzle.
11. Total surface treated — about 825 sq. ft. per charge.



Winter Formulas for Use at Temperatures Below 50° F.

IN ANY 4-GALLON SPRAYER.

1. Mark 6-quart water level inside sprayer tank by soldering a short piece of wire at the proper level.
2. Fill tank to this mark with *clean water*.
3. Add 2 quarts of winter concentrate.
4. Replace the air pump and screw it down tight.
5. Invert several times to mix the emulsion and to help seal the lid gasket.
6. Pump 55 full strokes to obtain proper operating pressure of 50 lbs./sq. in. (If compressed air is available and the sprayer provided with a Schrader valve, 55 lbs. pressure may be built up in the sprayer, in which case the entire contents may be sprayed without additional pumping).
7. Spray for about 4 minutes.
8. Repump 28 strokes to regain lost pressure.
9. Continue spraying until the tank is empty.
10. Total spraying time — 10 minutes per charge with an 8002 nozzle. About 13 minutes will be required when a 50015 nozzle is used.
11. Total surface treated — about 1900 sq. ft. per charge.

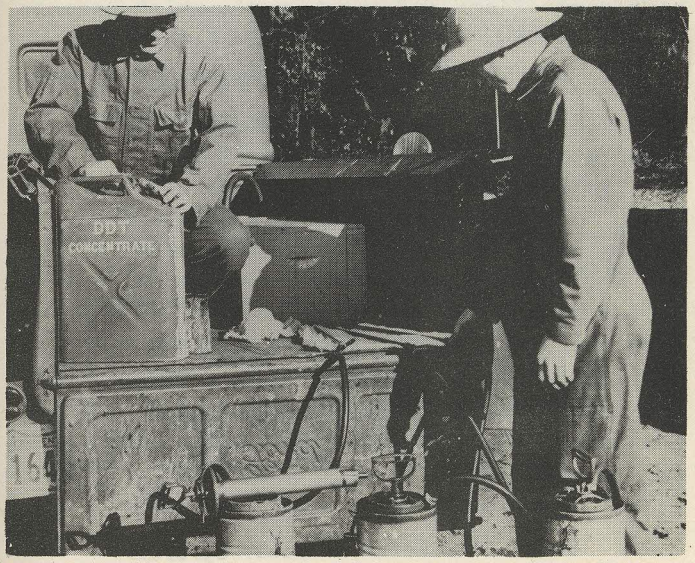
IN 3-GALLON MODIFIED LOFSTRAND SPRAYER.

1. Pour 4½ quarts of *clean water* into tank.
2. Add 1½ quarts of winter concentrate.
3. Replace the filler cap.
4. Pump or admit air until the pressure is 55 lbs./sq. in.

5. Spray the entire charge.
6. Total spraying time is 7 to 8 minutes per charge with an 8002 nozzle and 9 to 10 minutes with a 50015 nozzle.
7. Total surface treated is about 1430 sq. ft. per charge.

IN ANY 2½-GALLON SPRAYER.

1. Mark the 6-pint water level on the inside of the sprayer tank by soldering a short piece of wire at the proper level.
2. Fill tank to this mark with *clean water*.
3. Add 2 pints of winter concentrate.
4. Replace air pump and screw it down tight.
5. Invert several times to mix the emulsion and to help seal the lid gasket.



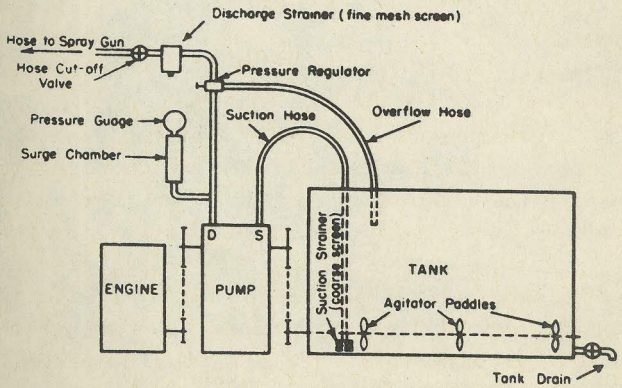
Hose, wand, and nozzle are protected from dirt.

6. Pump 41 full strokes to obtain the proper operating pressure of 50 lbs./sq. in.
7. Spray for about 2 minutes.
8. Repump 18 strokes to regain lost pressure.
9. Continue spraying until tank is empty.
10. Total spraying time is 5 minutes per charge with an 8002 nozzle and 6 to 7 minutes with a 50015 nozzle.
11. Total surface treated is about 950 sq. ft. per charge.

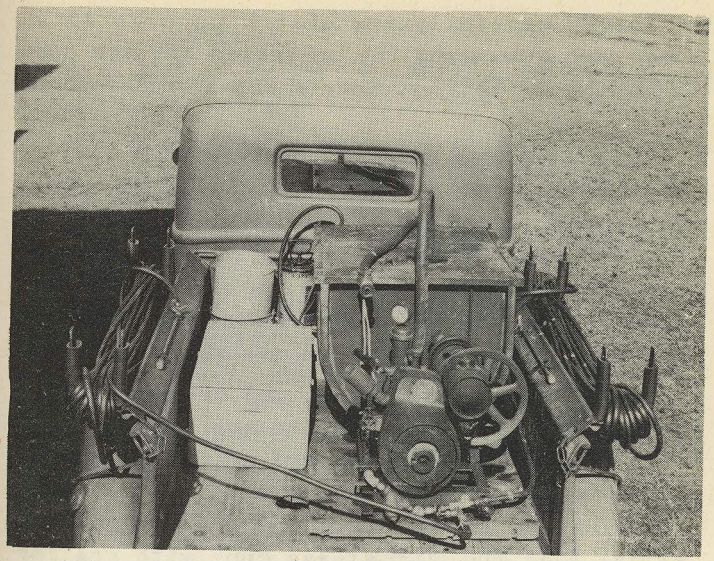
POWER SPRAYING

A power spray assembly can be used for treating thickly settled or urban areas where houses are built close together. The power sprayer has sufficient capacity to permit two or three hose connections and spray wands which permits a considerable reduction of operating time.

A power spraying unit consists of a small



Schematic Sketch of Power Sprayer



Power Sprayer Mounted on Truck

one-cylinder engine, a tank to hold 50 gallons of spray mixture, a V-belt driven pump, two 100-foot lengths of xylene-resistant moisture-proof hose, and two nozzles of the same type as those used in the hand spryyers.

The pressure regulator is adjustable and can be set for different pressures by changing the tension on the spring of the regulator valve. When the pressure of the liquid is greater than the pressure on the spring, the valve rises to permit the spraying liquid to flow into the tank through the overflow hose. Even though the outlet is completely shut off, the pump can be run with safety, because all the liquid will flow back into the tank through the pressure regulator and overflow hose.

Study carefully the sketch on page 42 so that you understand the operation of each part of the power sprayer. Locate all of these parts on the machine.

The first time the power sprayer is set up, it should be tested. The crew members should become familiar with its operation. Equipment should be examined carefully, the book of instructions studied, and directions followed. Special instruction plates on the engine and pump should be observed. These instructions are very important.

Learn how to start, stop, and oil the engine. Before attempting to operate the pump, lubricate it properly. Fill the cylinder sleeves with oil. The tops of the sleeves act as oil reservoirs for the lubrication of pistons and cylinder walls. Fill the pump grease cups with ***regular cup grease***, but the grease cup on the bearing of the tank agitator with ***water pump grease***.

After the householder has been notified, and the final preparations checked as described under **HAND SPRAYING**, mix the spray as outlined on page 45. Remove the hose from the rack, coiling it over your arm to keep it free from dirt. Proceed to the uppermost back room, uncoiling the hose as you go. Carry it completely around the pile of furniture in the center of the room and begin spraying near the door. This prevents dragging the hose into the room while you are spraying. When half the room is completed, spray the ceiling on that side. Spray the other half of the room in the same way, and proceed in the same manner through all the rooms in the house.

Operating the Power Sprayer

1. Pour 7 gallons of summer concentrate into the sprayer tank.
2. Add 42 gallons of water, to make 49 gallons of spray (or fill almost full, since tank capacity is 50 gallons).
3. Insert suction hose and overflow hose from pressure regulator into tank.
4. Start engine and watch pressure gauge.
5. Adjust pressure regulator until pressure shows 60 lbs. *Do not* open cut-off valve to hose until this is done.
6. Open hose cut-off valve and spray gun valves.
7. Adjust pressure to 60 lbs. again.
8. Allow engine to run 1 minute and then start spraying.
9. Check spray discharge before entering house.
10. Spray at the rate of 230 sq. ft. per minute. Practice with water in the tank until crew members can spray at this rate automatically.
11. Use small hand sprayer in places that cannot be reached conveniently by the hose of the power sprayer.
12. If partial recharges are necessary, add 6 gallons of water to each gallon of summer concentrate.
13. Use a measuring stick calibrated and marked in gallons to simplify adding correct amounts of water to sprayer tank.
14. Be sure that you have enough gasoline and lubricating oil for sprayer engine.
15. Check on tools, spare parts, and safety equipment as outlined on page 46.

After spraying inside the house is completed, coil the clean part of the hose over your arm and drag the dirty part to the next house. When the crew is ready to move to another location, coil the hose over the rack, keeping it off the ground. Clean the dirty part before returning the hose to the rack.

Before replacing the spray gun on its rack, clean the nozzle according to directions on page 37. Clean the nozzle screen after spraying several houses. After reassembling the nozzle, place the wand in its clip on the side of the truck. Fold all cover cloths, keeping the dirty side down. Repack cloths, reload equipment, and proceed to the next job.

List of Power Spraying Equipment

1. Five-gallon container for gasoline.
2. Respirators with extra filters.
3. Goggles with fog-proofing liquid.
4. Xylene-resistant, moisture-proof gloves.
5. Water jugs or drinking water fountain.
6. Funnel for filling crank case and gasoline tank.
7. Starter rope for gasoline engine.
8. One-gallon container for lubricating oil.
9. Repair kit for power sprayer.
10. Two sprayers.
11. Tool kit.
12. Quart measure.
13. Thread lubricant.
14. Fire extinguisher.
15. First aid kit.
16. Gasket shellac.

17. Cover cloths.
18. Two pails.
19. Clean rags.
20. Soap.
21. Talc.
22. Water pump grease.
23. Cup grease.
24. Small oil can.
25. Pouring spouts.

Care of Power Equipment

1. Clean discharge strainer *each noon* and *each night* by removing screen from pump outlet and washing it in water.
2. At end of each day's work:
   (a) Remove suction hose from the tank, being sure not to spill any of the emulsion.
   (b) Remove nozzle tip and strainer. Clean as outlined on page 37.
   (c) Insert spray guns into tank and start the pump.
   (d) Open shut-off valve and pump until all emulsion is returned to tank through the overflow hose.
   (e) Drain left-over emulsion into cans.
   (f) Remove overflow hose from tank.
   (g) Rinse power assembly by immersing suction hose in a pail of *clean water* and pumping it through the discharge piping and spray gun. This may require 3 to 5 gallons of *clean water*.
   (h) Place the end of overflow hose in the pail of water as soon as clean liquid emerges from it.

3. Do not return either suction hose or overflow hose to tank until you are ready to start the next day's operations.
4. Leave rinse water in pump and hose overnight, unless there is danger of freezing.
5. Discharge the water from hose and spray gun the next morning. Mix spray as before, but spray water out on the ground until the milky emulsion appears.

Maintenance of Power Equipment

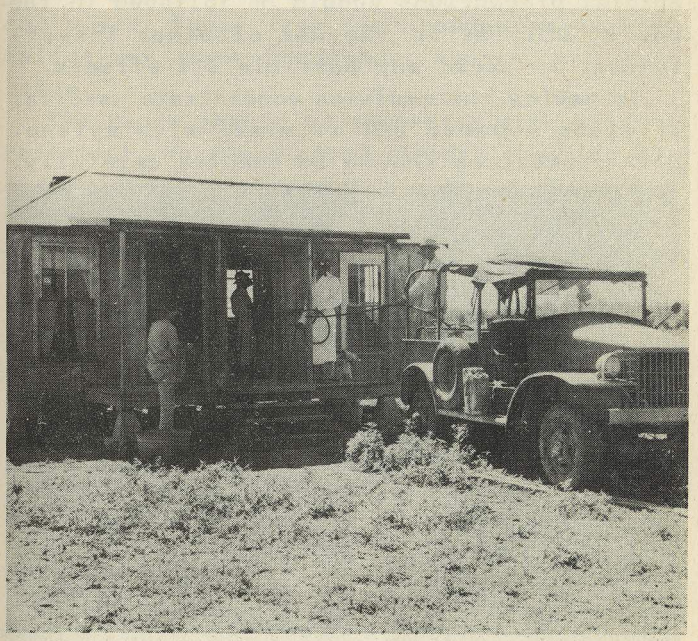
1. Do not mix oil with the gasoline used in the pump engine.
2. Always run engine with choke open.
3. Keep the glass cup of the strainer between gasoline tank and carburetor clean at all times. Clean the gasoline strainer when it is dirty.
4. Keep plunger guides floating in oil.
5. Keep pump bearing oiled or greased, according to the type of lubrication used.
6. Keep agitator shaft bearings lubricated with water pump grease.
7. Check oil level in engine crank case every day.
8. Change engine oil regularly (every 25 running hours), using SAE 30.
9. Refill air filter with clean oil, as recommended in the instruction booklet.

Using Power Sprayer to Mix Concentrate

Power sprayers can be used for mixing concentrate. Since the tank capacity is 50 gallons, the quantities recommended for the power

mixer can be used for the power sprayers.

The concentrate must *not* circulate through the pump. The agitator paddles in the tank must do the mixing. Place the suction hose and the pressure overflow hose in a pail of water so that the water can circulate through the pump while the concentrate is being mixed in the tank. If the pump is run with no liquid flowing through it, the plunger cups may be damaged. The concentrate may be emptied into drums or 5-gallon cans.

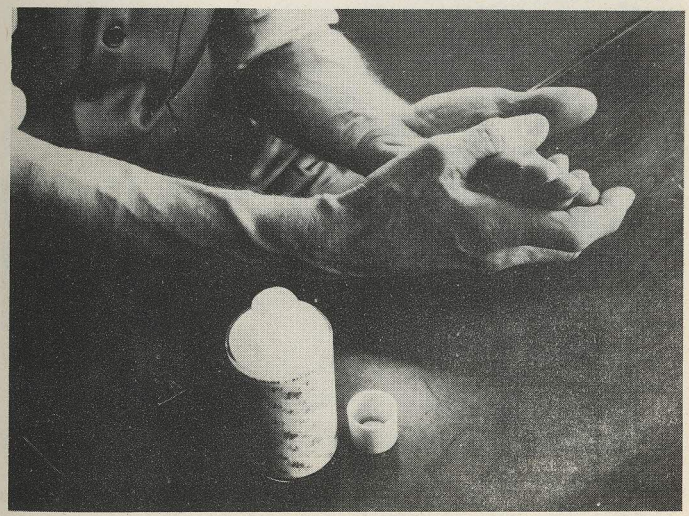


To be kept free of dirt, the spray hose should be coiled over the operator's arm and uncoiled as he proceeds to the rear of the house where work begins.

SAFE PRACTICES

DDT is deadly to many insects, but harmless to man if handled properly. Men who used DDT sprays continuously for several months have been given thorough medical checks. None showed any toxic effects as a result of exposure to the material. Toxic reactions may follow if large doses of DDT, say, a teaspoonful—are taken by mouth, or if skin is exposed constantly and excessively to DDT oil solutions. Special precautions should be followed in the use of DDT, as in the use of other insecticides, to avoid any possible ill effects.

In making the emulsion concentrate used for spraying houses, DDT is mixed with xylene. Both substances should be handled carefully.



Use Greaseless Skin Lotion

Dry DDT powder is harmless unless it is swallowed or allowed to remain on the skin too long. Greasy skin lotions should not be used when DDT is handled either in solution or in powder form, as grease or oil on the skin causes it to absorb DDT more quickly.

Although xylene has been used as a commercial solvent for many years, due care should be exercised in its use. It dissolves the natural oils of the skin, leaving it dry and cracked. This opens the way for germs to enter the skin and causes it to become inflamed. If xylene gets in the eyes it causes them to burn and smart. Fumes from high concentrations of xylene may cause headaches, nausea, and vomiting.

The hands should be protected with xylene-resistant, moisture-proof gloves in mixing DDT and xylene. Indoor mixing must be done in a well-ventilated room, with an exhaust fan to carry off the fumes. A respirator is worn for additional protection.

DDT-xylene concentrate must never remain on the skin or be allowed to saturate work clothes. Wash the hands often with soapy water to keep them free of the concentrate. If concentrate is spilled on work clothes, they should be changed promptly and the affected part of the skin washed thoroughly. It is always necessary to use care in handling DDT-xylene concentrate.

The spray emulsion should never be mixed near an open well, where there is danger of spilling it in the drinking water. After the spray tank has been filled, wipe it with a

clean, dry rag, and wash hands thoroughly.

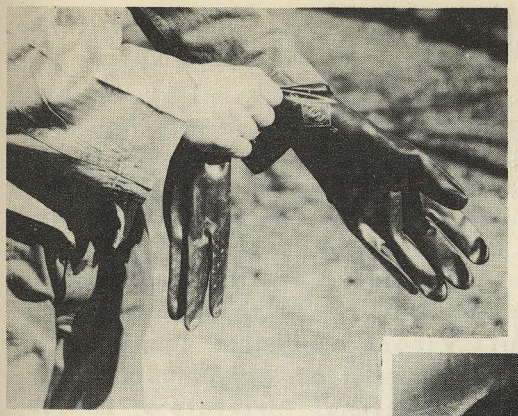
Wear goggles while spraying to protect the eyes, and a respirator to keep spray out of the lungs. Wash hands and face frequently. Keep spray wiped off the skin with a clean cloth.

Children's beds and toys should not be sprayed. Food, dishes, and cooking utensils should be removed before the kitchen, dining room, or pantry are sprayed. Sick persons should not remain in rooms which are being sprayed. Wipe up immediately any emulsion spilled in the house.

As spraying operations are completed in each house, hands should be rewashed. A greaseless skin lotion may be applied if the hands become chapped. A good soapy bath and a change of clothes should follow each day's work. Clean work clothes should be put on every other day. If work clothes become soaked with spraying liquid or concentrate, they must be changed immediately.

DDT must be labeled properly. The powder resembles flour, so it should never be stored near food. If one should accidentally swallow DDT, he should drink mustard water immediately. This is made by adding one tablespoonful of powdered mustard to a glass of warm water. Mustard water causes vomiting. A physician should be consulted at once.

The supervisor should be informed of any severe headaches, skin eruptions, or other indications of bodily disorders. So far as is known, no person has ever been poisoned by DDT. These have been reports of skin rash and



ABOVE: Wear xylene-resistant, water-proof gloves.

RIGHT: Wash any part of the skin that touches DDT concentrate.

BELOW: If DDT is swallowed drink mustard water.

dizziness after spraying all day, but these are typical reactions to excessive xylene exposure.

Harmful effects resulting from the use of DDT spray may be avoided by routine observance of the precautions just discussed. (For summary, see below.) Any toxic reaction to the spray shown by an employee of Public Health Service should, however, be referred immediately to a physician. If DDT poisoning is suspected, a full report should be submitted to Dr. Paul A. Neal, Chief of the Industrial Hygiene Laboratory, National Institute of Health, Bethesda, Maryland.

SAFE PRACTICES WHILE SPRAYING

1. Wear *goggles* to protect eyes and a *respirator* to protect lungs.
2. Wear *proper clothing*, a wide-brimmed hat, and xylene-resistant, mositure-proof gloves.
3. Use a *greaseless skin lotion* to prevent chapping resulting from exposure to xylene.
4. *Wipe face* frequently with clean cloth and avoid rubbing spray into eyes.
5. *Wash hands* frequently in soapy water.
6. Take a good soapy bath and change clothes after each day's work.
7. Change clothes *immediately* if they become soaked with spray. *Wash* any part of the body touched by the solution.
8. *Do not spray* baby beds, children's toys, high chairs, food, dishes, silverware, or rooms occupied by sick persons.

IF SKIN OR EYE IRRITATION OCCURS

1. Report such irritation to supervisor.
2. Report to supervisor *severe headaches, dizziness*, or *other illness*.
3. Use *greaseless* lotion for chapped hands.
4. Treat inflamed skin with warm boric acid or salt water until physician is seen.
5. *Treat* eye irritation with warm boric acid solution until physician is seen.

IF DDT IS SWALLOWED

1. Drink *mustard water IMMEDIATELY* to induce vomiting. (One tablespoon dry mustard in glass of warm water.) Consult a physician at once.

SUGGESTIONS FOR DEALING WITH THE PUBLIC

The Extended Program must be sold to the people. It *cannot be forced* upon them. The success or failure of residual spraying depends to a great extent upon the attitude developed in the people concerned. Not only should they be willing to have their houses sprayed, but they must be so desirous of having the work done that they will cooperate actively in preparing their houses for the spraying crews.

If a *favorable public attitude* toward the Extended Program is created through the proper approach, householders will make all preparations for spraying. The crew is thus able to

Attitude of the Householder Depends upon Crew Members

spend all its time on the actual spraying job, and the work progresses satisfactorily.

The attitude of the people depends largely upon the manner in which they are approached. To the people of each community, the field crew represents the State and local health departments, so the attitude and conduct of each individual crew member during spraying operations is of utmost importance in making the Extended Program a success.

Passive compliance of householders is undesirable. If they allow their houses to be sprayed as a "favor" to the health department, they expect you to move the furniture and

prepare the house for spraying. In addition, they expect *you* to replace the furniture after spraying is completed. This takes about five to ten times as long as the actual spraying. At this rate the program is costly and proceeds slowly.

Crew Members Ready for Work.

A *hostile public attitude* toward the Extended program can cause it to fail. If householders refuse to have their houses sprayed their lack of cooperation may spread to other communities.

The procedures and benefits of DDT spraying may be explained to the people through community meetings held several weeks before the beginning of the Extended Program. The malaria control assistant will probably conduct these meetings.

In these meetings the *beneficial effects*

Sprayer Ready for Use

of DDT should be stressed. Its value in malaria control should be pointed out. It should be made clear that DDT residual spray is not like the ordinary house sprays. DDT is not a quick killer; emphasis should be placed on the fact that its killing power may extend over a period of four months or longer. People should be made to realize that some mosquitoes may bite them occasionally, but that the mosquitoes which rest on a sprayed surface for 30 minutes or more will be killed.

DDT emulsion is milky white when it is sprayed. When the water evaporates from a sprayed surface, the residue is a thin coating of almost invisible crystals, hardly noticeable on light walls or wallpaper. They may show

slightly on dark or varnished surfaces but can be removed with furniture polish. The spray does not harm walls, curtains, wallpaper, or furniture.

It should be explained that insects are killed by contacting DDT crystals, but man and higher animals are not. DDT crystals must be eaten or absorbed through the skin in oil solutions to cause harm to these higher forms of animal life. A baby would have to lick about 10 square feet of treated surface to suffer any ill effects.

One of the best selling points for DDT house spraying is the assurance that it will control other common insect pests. The housewife will not hesitate to have her home treated if she realizes that the spray will control such pests as houseflies, cockroaches, and bedbugs. Frequently, the effect of DDT on these insects is more impressive than its effect on mosquitoes. The presence of dead flies and cockroaches is very noticeable. The destruction of bedbugs is greatly appreciated. (See special directions on pages 63 to 65.)

The purpose of the program is malaria control, but it is considered good policy for the crew to do some extra spraying to control other pests if the householder desires. Extra time spent in spraying a cupboard for cockroaches or a mattress for bedbugs is well repaid from the standpoint of public relations. It is well to stress the fact that the crew will do a careful job and protect all materials that the owner does not wish to have sprayed.

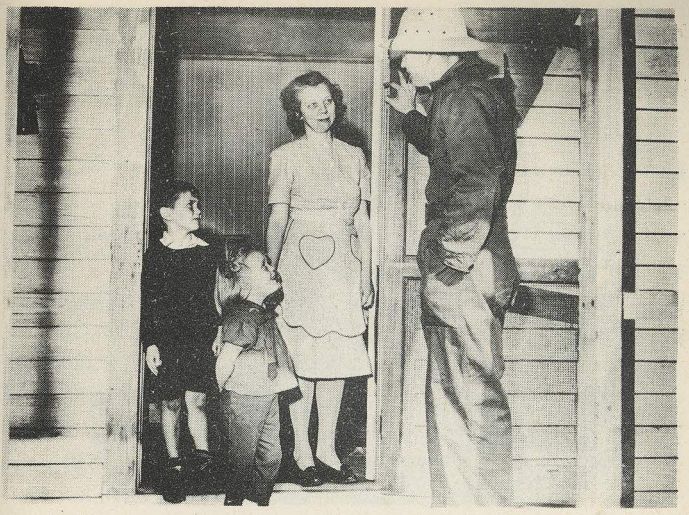
Spray crews should be considerate when entering homes, as they are there only on the invitation of the owners. Some rules to follow are:

1. Use good judgment and tact.
2. Respect private property rights.
3. Do not argue with a householder.
4. Refer difficult problems and questions to supervisor.
5. Avoid any suspicious actions that might later result in charges of theft or misconduct.
6. Be careful of dogs and other pets.
7. Wipe your shoes before entering the house.
8. Handle cloths carefully so that no glassware or other objects are broken.
9. Keep in mind that your conduct affects the success of the entire program.
10. Remember — *you* represent the local health department. *Govern yourself accordingly*.

SUGGESTED INTRODUCTORY STATEMENT TO HOUSEHOLDER

"Good morning. We're from the _____ County Health Department. We'd like to spray your house with DDT to help you control mosquitoes and other insects. When the spray dries on your walls and ceilings, you can hardly see it. It won't hurt you and your children, nor your pets, but when mosquitoes, roaches, and flies crawl over it, they die. The effects of the treatment last three or four months.

Is it all right for us to come in?



Enlisting Home Cooperation

ANSWERS TO QUESTIONS FREQUENTLY ASKED

HOW MUCH DOES IT COST? There is no charge. The Health Department is doing it to prevent malaria in this state.

DO INSECTS DIE AS SOON AS THEY TOUCH THE WALLS? No. It takes half an hour or longer.

HOW LONG WILL IT LAST? The effect of the spray lasts a long time — for several months. If we spray your house today, mosquitoes — especially the kind that carry malaria — will be killed any time they crawl over your walls and ceilings during the next 3 or 4 months.

IS IT POISONOUS? It kills insects. Once it's on the wall, it won't hurt people. A baby would have to lick about 10 square feet of

Remove all wall hangings.

the surface of the wall to get enough to hurt him. We don't spray dishes or food or anything that might carry the spray to the food.

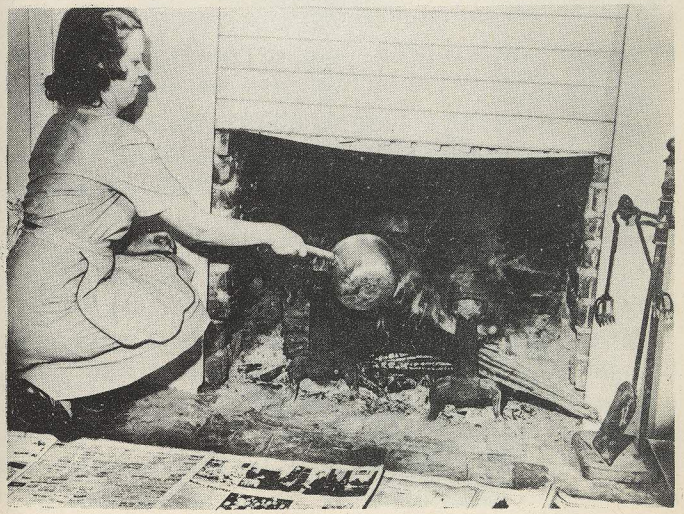
HOW IS IT PUT ON THE WALLS? We use a small hand sprayer like the one you use in your garden. It has a special nozzle which gives a very fine spray that hardly dampens the wall. It won't harm wallpaper or curtains. When it dries you can hardly see it. We cover furniture and varnished surfaces to protect them from the spray.

HOW LONG WILL IT TAKE? If you have your house ready for us when we come, it will take only about 20 minutes. The spray dries in half an hour, and everything can be put back in place in a few minutes.

CONTROL OF OTHER INSECT PESTS WITH DDT

Control of other household ptsts may be of indirect health importance. Members of the crew can improve public relations and facilitate the work of the Extended Program by following the suggestions given here. Refer to the handbook, "DDT FOR THE CONTROL OF HOUSEHOLD INSECTS AFFECTING HEALTH", for additional information.

COCKROACHES are most active at night. During the day they hide in dark sheltered places, so DDT must be forced into cracks and crevices, where they are usually found. Legs and undersurfaces of tables and chairs should be sprayed. Treatment should be given to walls, ceilings, and



See that all fires are extinguished.

floors of kitchens, pantries, and other places where food is handled and stored. Special attention should be given to cracks in and around cupboards, sinks, plumbing, and wherever particles of food accumulate. Do not spray food and dishes.

BEDBUGS hide in cracks and crevices during the day and come out at night to suck blood. Hence, DDT spray must be directed toward their daytime hiding places. Apply DDT spray to bedsteads, paying particular attention to joints and to cracks in the wood. Spray springs and mattresses thoroughly, especially the folds and crevices around the mattress tufts or buttons. Spray the walls and floor around the beds, particularly in crevices where bugs might hide, and behind any loose paper where they would be likely to congregate.

The fine, even spray will not harm wallpaper.

HOUSEFLIES. DDT sprayed on walls and ceilings, especially in kitchen and pantry, cuts down the fly population. Spray window and door screens, sides of the house around front and back entrances, back porch, and kitchen entrance. Spray in and around garbage cans and privies. Spraying barns and stables is desirable but cannot be undertaken at this time on the Extended Program.

FLEAS. Flea control is directed against immature stages of the insect. Eggs drop from animal hosts to the floor, where larvae develop in dust and debris in cracks and corners, under rugs, and in mats where animals are accustomed to lie. All these places should be sprayed. Adult fleas are found on dogs and cats and frequently attack man. Pets should not be sprayed, as DDT in oil solution may be absorbed by the skin and cause the animal to die. Kennels and sleeping quarters may be sprayed.

CONTROL OF THESE INSECT PESTS IS OF SECONDARY IMPORTANCE IN THE EXTENDED PROGRAM. THE MAIN PURPOSE IS MALARIA CONTROL.

OTHER MOSQUITO-BORNE DISEASES. In the future, DDT residual spray programs may be directed against vectors of other diseases, such as yellow fever, dengue, filariasis, encephalitis, equine encephalomyletis, and Japanese B encephalitis. Vectors of these diseases do not rest in houses and other domestic shelters as characteristically as anophelines do. Spraying may be of some value, however, in the event of epidemics of these diseases.

LIQUID VOLUME EQUIVALENTS

ONE GALLON	4	QUARTS
	8	PINTS
	16	CUPS
	128	OUNCES
	3785	CUBIC CENTIMETERS
ONE QUART	¼	GALLON
	2	PINTS
	4	CUPS
	32	OUNCES
	946	CUBIC CENTIMETERS
ONE PINT	1/8	GALLON
	½	QUART
	2	CUPS
	16	OUNCES
	473	CUBIC CENTIMETERS
ONE CUP	1/16	GALLON
	¼	QUART
	½	PINT
	8	OUNCES
	236	CUBIC CENTIMETERS

WEIGHT EQUIVALENTS

ONE POUND	16.	OUNCES
	0.4536	KILOGRAMS
	453.6	GRAMS
	453,600.	MILLIGRAMS
ONE OUNCE	1/16	POUNDS
	0.02835	KILOGRAMS
	28.35	GRAMS
	28,350	MILLIGRAMS
ONE KILOGRAM	2.204	POUNDS
	35.27	OUNCES
	1,000.	GRAMS
	1,000,000.	MILLIGRAMS
ONE GRAM	0.00224	POUNDS
	.03527	OUNCES
	.001	KILOGRAMS
	1,000	MILLIGRAMS

NOTES